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BASIC SKILLS RESOURCE CENTER:

Development and Evaluation of Computer-
Based Learning Strategy Training Modules

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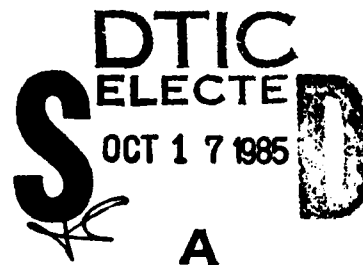
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The overall goal of this project was to develop computer-based learning strategy training modules designed to facilitate the acquisition and application of technical information. These modules combine the strengths of two promising instructional techniques: computer-assisted instruction and cooperative learning (peer tutoring). Over the course of this project we have developed and formally evaluated three modules designed to improve cognitive strategies during text processing: Summarization (paraphrase/imagery), Structured

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BLOCK 20 ABSTRACT (continued)

Summarization (DICEOX), and Networking. We have also developed and informally evaluated a module designed to improve affective strategies. The results of these evaluations indicate that this training approach is effective for simple and somewhat familiar strategies (i.e., paraphrase/imagery). However, under the experimental conditions imposed, the approach does not appear to be very effective for complex, unfamiliar strategies such as Networking and DICEOX. Suggestions are provided for improving the effectiveness of this training by extending training time and integrating the modules.

Executive Summary

The overall goal of this project was to develop computer-based learning strategy training modules designed to facilitate the acquisition and application of technical information. These modules combine the strengths of two promising instructional techniques: computer-assisted instruction and cooperative learning (peer tutoring). In overview, pairs of cooperating students interact with a microcomputer and each other in learning metacognitive and cognitive strategies for processing complex, scientific information. The microcomputer provides strategy instructions, initiates training tasks, monitors the training activities, and provides expert content and process feedback and reinforcement to the learner. The students serve as models for one another, and, in cooperation with the computer, assist each other in analyzing and diagnosing the productions that emerge from applying the strategies.

This combined methodology, which is labeled Computer-Assisted Cooperative Learning (CACL), capitalizes on the economical source of content and process expertise and management capabilities that can be programmed into the computer, and the interpretive capabilities and potential for social modeling available in human interactions. (It should be noted that this paradigm does not <u>necessarily</u> require the presence of two students; a single student can be instructed to play both roles.)

We have developed and formally evaluated three modules designed to improve cognitive strategies during text processing: Summarization (paraphrase/imagery), Structured Summarization (DICEOX), and Networking. All three of these modules included training on the general MURDER strategies developed by Dansereau, McDonald et al. (1979). The input strategy, 1st Degree MURDER, includes six steps for learning text material: (1) setting a proper <u>Mood</u> for learning, (2) reading for <u>Understanding</u>, (3) <u>Recalling</u> the information, (4) <u>Detecting</u> errors or omissions in the recall, (5) <u>Elaborating</u> to make the material more easily remembered, and (6) a final <u>Review</u>.

The 2nd Degree MURDER strategy includes six steps for using the acquired information during task performance: (1) getting into a proper <u>Mood</u> for the task, (2) <u>Understanding</u> the goals and conditions

of the task, (3) <u>Recalling</u> information relevant to
the task, (4) <u>Detecting</u> omissions, errors, and ways
of organizing the information, (5) <u>Elaborating</u> the
information into a proper response, and (6) <u>Reviewing</u>
the response to modify it if necessary.

The basic difference between the three modules
occurs in the "Recall" step of the two MURDER strategies.
In the Summarization module the individual recalls
in his/her own words and images, in the Structured
Summarization module the recall is organized into
a set of prescribed categories, and in Networking
the recall is organized in the form of node-link
maps. The evaluations of these three modules and
an additional one designed to improve affective strategies
have indicated that the CACL training approach is
very effective for simple and somewhat familiar strategies
(i.e., Summarization). However, under the experimental
conditions imposed, the approach does not appear
to be very effective for complex, unfamiliar strategies
such as Structured Summarization and Networking.
Suggestions are provided for improving the effectiveness
of this training by extending training time and integrating
the modules.

Foreword

This final report is the culmination of a successful
research project. As usual such a project requires
a "team" effort. In this regard, we would like to
thank the individuals at InterAmerica Research Associates,
Inc., The Army Research Institute, and Texas Christian
University who played an active role in the success
of this project. In particular, we would like to
thank Rocco Russo, the Project Director at InterAmerica
for his excellent guidance and support.

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Development and Evaluation of
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I. Project Objectives

The overall goal of this project was to develop computer-
based learning strategy training modules designed to facilitate
the acquisition and application of technical information.
These modules combine the strengths of two promising instruc-
tional techniques: computer-assisted instruction and cooperative
learning (peer tutoring). In overview, pairs of cooperating
students interact with a microcomputer and each other in
learning metacognitive and cognitive strategies for processing
complex, scientific information. The microcomputer provides
strategy instructions, initiates training tasks, monitors
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students serve as models for one another, and, in cooperation
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nosing the productions that emerge from applying the strategies.

This combined methodology, which is labeled Computer-
Assisted Cooperative Learning (CACL), capitalizes on the
economical source of content and process expertise and manage-
ment capabilities that can be programmed into the computer,
and the interpretive capabilities and potential for social
modeling available in human interactions. (It should be
noted that this paradigm does not necessarily require the
presence of two students; a single student can be instructed
to play both roles.)

II. Summary of Accomplishments

During the course of this project we have accomplished
the following:

A. We have developed and formally evaluated three learning
strategy training modules: Summarization (paraphrase/imagery),
Structured Summarization (DICEOX), and Networking. These
modules are described in detail in subsequent sections of
this report and copies of the training materials (computer
disks, documentation, and written transcripts have been
delivered to the Project Director).

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B. We have developed and informally evaluated a module designed to improve affective strategies (Mood Management). This module, which is described subsequently, has been designed to serve as a "front-end," preparatory component for the other three modules.

C. We have modified the Summarization (paraphrase/imagery) module based on the formal evaluation, and have delivered the modified training materials to the Project Director.

D. We have modified the Networking and Structured Summarization modules and have delivered these to the Project Director.

E. We have presented the following papers describing the results of this research and development effort:

1. Rocklin, T. R., & Dansereau, D. F. Development and evaluation of computer-based learning strategy training modules. Presented at the National Reading Conference, December 1983, Austin, TX.

2. Hythecker, V. I., Dansereau, D. F., Rocklin, T. R., Lambiotte, J., G., Larson, C. O., & O'Donnell, A. M. The development and evaluation of a computer-based learning strategy module: Paraphrase/imagery. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, April 1984.

3. Dansereau, D. F. Computer-based learning strategy training modules: A progress report. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, April 1984.

F. We have had two papers accepted for publication:

1. Hythecker, V. I., Rocklin, T. R., Dansereau, D. F., Lambiotte, J. G., Larson, C. O., & O'Donnell, A. M. The development and evaluation of a computer-based learning strategy module. Submitted to Journal of Educational Computing Research, in press, 1984.

2. Rocklin, T. R., O'Donnell, A. M., Dansereau, D. F., Lambiotte, J. G., Hythecker, V. I., & Larson, C. O. Training learning strategies with computer-aided cooperative learning. Computers and Education, in press, 1984.

G. We have prepared two additional papers that are available as unpublished manuscripts:

1. O'Donnell, A., Dansereau, D. F., Rocklin, T. R., Larson, C. O., Hythecker, V., Lambiotte, J. G., & Young, M. Structured summarization (DICEOX): Development and evaluation of a CACL module. Unpublished manuscript, Texas Christian University, 1984.

2. Hythecker, V., Dansereau, D. F., Rocklin, T. R., O'Donnell, A., Lambiotte, J. G., Larson, C. O., & Young, M. Networking: Development and evaluation of a CACL module. Unpublished manuscript, Texas Christian University, 1984.

III. Development and Evaluation of the Learning Strategy Training Modules

In this section we provide detailed descriptions of the development and evaluation of the four modules: Summarization (Paraphrase/Imagery), Networking, Structured Summarization (DICEOX), and Mood Management.

A. Development and Evaluation of the Summarization (Paraphrase/Imagery) Module

There are now a number of research and development efforts oriented toward the direct improvment of cognitive strategies employed by learners (O'Neil, 1978; O'Neil & Spielberger, 1979). Our own research has supplied substantial evidence that an individual's capacity for acquiring and using information can be improved with direct training on appropriate strategies for information processing (e.g., Dansereau, Collins et al., 1979; Dansereau, McDonald et al., 1979; Holley, Dansereau, McDonald, Garland, & Collins, 1979).

Although there appear to be a number of effective cognitive and metacognitive strategies emerging from basic research efforts, their utility is severely limited by difficulties in communicating them to learners (Dansereau, in press). Training adults to incorporate new learning strategies into their repertoires is plagued with all of the problems present in complex motor skills re-training (e.g., Singer, 1978), plus additional complexities arising from the covert nature of cognitive and metacognitive activity. This research project, therefore, deals with the development of an improved methodology for learning strategy training.

The approach used in the learning strategy training is a combination of two technologies: computer-assisted instruction and cooperative learning (peer tutoring). The

training module resulting from this combination utilizes the strengths of the two technologies while eliminating the weaknesses of each. In subsequent paragraphs we provide background information on each of these approaches.

With the advent of flexible, economical microcomputers, it is clear that in the future computers will be one of the major instructional delivery systems. With respect to learning strategy training, computer-assisted/managed instruction has several important strengths. Specifically, it can (a) provide an economical (in comparison to human experts) source of expertise in both subject matter and process, (b) control, monitor, and reinforce the flow of learning activities in an objective and efficient manner, (c) keep track of subject responses for future analysis, and (d) tailor training activities based on pre-training individual difference measures and on responses to tasks within the training sequence.

On the other hand, there are two major weaknesses with this approach as it applies to strategy training. First, effective learning strategies usually require the learner to produce alternate versions of the text information. Although there has been progress in the development of natural language interpreters, we are a long way from having systems that can analyze and diagnose free recalls and elaborations of text, which are important indicators of the degree of acquisition of a body of knowledge.

A second weakness is the fact that computers cannot provide a convincing model for students to imitate and to use as a basis for evaluating their own relative strengths and weaknesses. This is unfortunate, in that it is clear (Dansereau, in press) that one of the most potent methods of communicating skills and strategies in general and learning strategies in particular is social modeling (i.e., demonstrations of strategy usage).

Cooperative learning (peer tutoring) is another training methodology with potential for improving the acquisition of knowledge and skills. Not only do students studying textbook material in cooperating dyads perform better on delayed recall and recognition measures than students studying individually (Dansereau, Collins et al., 1979; McDonald, Larson, Dansereau, & Spurlin, 1984), but there is also evidence of positive transfer of learning skills from the dyadic experience to subsequent individual studying (McDonald et al., 1984). In addition to improvement in cognitive skills, cooperative learning has led to positive effects on measures of self-esteem, altruism, and mutual concern (see reviews by Sharan, 1980, and Slavin, 1980).

The cooperative learning paradigm, utilizing two students interacting over a segment of text, has two salient strengths. First, the participants have an opportunity in this situation to observe and imitate each other's processing. Students can learn new strategies from their partners even without instructions to do so. In addition, cooperating students can gain insights with regard to their relative levels of cognitive effort, persistence, and affective control. Second, the students can evaluate, diagnose, and correct each other's productions. Since only humans are able to tolerate ambiguities and transcend grammatical misconstructions, it is clear that they are the only available processors that can interpret the unrestrained natural language present in the free recall of information.

Obviously, the cooperative learning paradigm is not without weaknesses. In our experience the most important of these is that often neither cooperating student has the necessary content and/or process expertise to maximize the learning experience. This can result in a type of "blind leading the blind" scenario which may be detrimental for both parties involved. In addition, many pairs of students have difficulty staying on the task and effectively managing their available time and resources.

Computer-Assisted Cooperative Learning (CACL) training modules combine the strengths and offset the weaknesses of the two component technologies, computer-assisted instruction and cooperative learning. The computer programs provide cooperating pairs of students with the necessary data base for adequate content and processing expertise, and control the flow of activity. At the same time each student in the pair acts as a model for the other student and provides properly adaptive evaluations of the other person's productions.

The first application of the CACL methodology was designed to train students on the use of the MURDER text processing strategies developed by Dansereau, McDonald et al., (1979). The input strategy, 1st degree MURDER, includes six steps for learning text material: (1) setting a proper Mood for learning, (2) reading for Understanding, (3) Recalling the information using verbal paraphrases and descriptions of images, (4) Detecting errors or omissions in the recall, (5) Elaborating to make the material more easily remembered, and (6) a final Review.

The 2nd Degree MURDER strategy includes six steps for using the acquired information during task performance: (1) getting into a proper Mood for the task, (2) Understanding the goals and conditions of the task, (3) Recalling information relevant to the task, (4) Detecting omissions, errors, and ways of organizing the information, (5) Elaborating the information into a proper response, and (6) Reviewing the response to modify it if necessary.

During training the students were given instructions and practice on using 1st and 2nd Degree MURDER in learning and recalling medically related text excerpts. Particular emphasis was placed on the Recall (1st R) steps in which students were trained to paraphrase the text in their own words and to construct visual images as alternative representations of the text information. To evaluate the CACL methodology, a group of students trained in this fashion were compared with students given the same instructions and practice individually via written materials, and with students who studied the practice materials using their regular study and test-taking methods. Following training, all students, regardless of group affiliation, individually studied and took free recall tests over two passages. The first passage, which was medically related, was included to assess direct (near) transfer of training, and the second, which contained technical but non-medical content, was included to assess indirect (far) transfer.

Method

Participants

Participants in this experiment were 89 students from introductory psychology classes at Texas Christian University who were fulfilling a course requirement.

Materials

The training materials used in this experiment were designed by the authors to guide the students in the use of the $MURDER_1$ and $MURDER_2$ strategies. Practice passages containing medical information were provided during training. Two additional passages were used to assess the effectiveness of the strategy training.

The first, which focused on descriptions, causes, and treatments of tumors (1,100 words), was selected to be similar to the practice passages. Performance on this served to assess direct (or near) transfer. The second passage was also technical in nature, but did not contain medical information. This 800-word passage, which described the fictional development and operation of an orbital tower connecting the earth to a satellite, served to assess indirect (or far) transfer.

Two individual difference measures were used as covariates in the analysis of treatment effects. The Delta Vocabulary Test (Deignan, 1973) is a 45-item multiple-choice test that correlates moderately with other measures of verbal aptitude (Dansereau, 1978). The Group Embedded Figures Test was developed by Oltman, Raskin, and Witkin (1971) to assess field dependence/independence. The individual must detect a simple geometrical figure contained within each of 18 more complex figures.

This measure has been shown to be positively correlated with text processing performance (Witkin, Oltman, Raskin, & Karp, 1971).

Procedure

Each participant attended three two-hour sessions conducted during a two-week period. During the first session participants were randomly assigned to one of three conditions: a Computer-Assisted Cooperative Learning (CACL) group (n=30), an Individual Learning Strategy Group (n=28), or a No-Treatment Group (n=31).

The CACL group worked in randomly assigned same-sex pairs and received computer-based training in paraphrasing and the use of imagery as a means of implementing the 1st and 2nd Degree MURDER strategies. The pair partners interacted with one another and the Apple II microcomputers in learning these strategies. Medically related passages served as practice materials during this training.

The Individual Learning Strategy group was given transcripts of the CACL computer programs as training materials. They studied this material individually. Training was identical to that of the CACL group. The No-Treatment group was exposed to all of the practice passages given the other two groups. They were told to use their own methods in studying these passages.

During the second session, the CACL and Individual groups took 15 minutes to complete their training. The Control group spent this time writing an essay on the practice content material. Each group then studied a medically related passage on tumors for 30 minutes and a non-medically related passage on the fictional construction of an orbital tower for 40 minutes. All participants studied both passages individually.

During the third session all participants took free recall tests which required them to list all the important ideas and facts they remembered from each of the two assessment passages (Tumors test--18 minutes; Orbital Tower test--18 minutes). Then the subjects completed the Delta Vocabulary Test (Deignan, 1973)--10 minutes, and the Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971)--12 minutes. These two measures were used as covariates in the analysis of free recall performance. Subsequently, the CACL and the Individual groups completed a Satisfaction Questionnaire of 26 items, and the No-Treatment group answered an open-ended question about how they studied the passages.

Results

Trained raters scored the lists of ideas according to a predetermined key for main ideas and details without knowledge

of a participant's group affiliation. There was one team of three raters for each of the passages. Two raters on each squad scored half the free recalls, and the third rater scored a subset of each of the other two. The Orbital Tower passage raters achieved inter-rater reliabilities of 0.86 and 0.81 for main ideas and 0.96 and 0.87 for details. The Tumors passage raters achieved reliabilities of 0.96 and 0.96 for main ideas, and 0.92 and 0.92 for details.

Two-way analyses of covariance with passages as the repeated measure and the Delta Vocabulary Test and the Group Embedded Figures Test as covariates indicated significant differences among the three experimental groups for totals of main ideas and details $F(2, 86) = 4.50$, $p < 0.02$, for main ideas only, $F(2, 86) = 4.28$, $p < 0.02$, and for details only, $F(2, 86) = 3.43$, $p < 0.04$. Effects due to passages and passage-treatment interactions were nonsignificant. Adjusted and unadjusted means and standard deviations for each group are listed in Table 1. The parallelism of the within-cell regression slopes was tested for each analysis, and in all cases the regression slopes were found to be homogeneous.

Post hoc analyses indicated that the significant main effects could all be accounted for by the differences between the CACL group and the Control group. Tukey's HSD was exceeded by the differences in the means for the CACL group and the Control group for total points, for main ideas, and for details ($p < .05$). No other differences reached significance.

Principal components factor analysis of the satisfaction questionnaire revealed two factors: one, an evaluation of the overall effectiveness of the learning strategy and the other, a judgment of how the training experience affected the student personally. The first factor accounted for 45.7% of the variance and the second for 17.7%.

Two scales were constructed by adding together (with unit weightings) those items with factor loadings greater than 0.50. Using this criteria twelve items were included in the creation of the first scale and seven items were included in the second (coefficient alpha = 0.79 and 0.86, respectively). To assess group differences on the scales, two t-tests were run, and results indicated that the CACL group evaluated their training program as more effective than did the individuals, $t(56) = 2.30$, $p < 0.03$; and also reported more personal gain, $t(56) = 1.98$, $p < 0.06$. Table 2 has the means and standard deviations for the questionnaire scales.

Discussion

This study involved the development and evaluation of a training module (CACL) that uses both computer-assisted

Table 1

Standardized Means and Standard Deviations for CACL Group
vs. Individual Strategy Group vs. Control Group on Recall
of Total Ideas, Main Ideas, and Detail Ideas

		TOTAL		MAIN		DETAIL	
		Unad-justed	Ad-justed	Unad-justed	Ad-justed	Unad-justed	Ad-justed
CACL (n=30)							
Tumors	M	0.36	0.29	0.30	0.24	0.37	0.32
	SD	1.01	0.86	1.00	0.93	1.00	0.85
Orbital Tower	M	0.43	0.37	0.33	0.27	0.33	0.28
	SD	0.98	0.97	0.96	0.93	1.00	0.96
INDIVIDUAL STRATEGY (n=28)							
Tumors	M	-0.04	-0.02	-0.06	-0.05	-0.01	0.01
	SD	1.06	0.96	0.98	0.88	1.05	0.97
Orbital Tower	M	0.00	0.02	0.19	0.20	-0.03	-0.02
	SD	1.01	0.93	0.92	0.86	1.02	0.97
CONTROL (n=31)							
Tumors	M	-0.34	-0.31	-0.23	-0.19	-0.36	-0.31
	SD	0.89	0.71	0.99	0.75	0.86	0.81
Orbital Tower	M	-0.33	-0.29	-0.46	-0.41	-0.21	-0.17
	SD	1.01	0.83	0.97	0.91	1.00	0.83

Table 2

Means and Standard Deviations for CACL Group vs. Individual Strategy Group on Factor 1 and Factor 2 of Post-Experimental Questionnaire

	Factor 1 (12 items)		Factor 2 (7 items)	
	Mean	SD	Mean	SD
CACL (n=30)	6.39	0.93	5.99	1.43
Individual Strategy (n=28)	5.68	1.35	5.18	1.68

instruction and cooperative learning to facilitate the acqui-
sition of learning strategies. It was expected that the
Computer-Assisted Cooperative Learning (CACL) group would
outperform both a group in which students working as individuals
received the same learning strategy instructions and practice
materials as the CACL group and a control group in which
participants studied the practice material using their preferred
methods of studying.

Statistical analysis of the scores on free recall tests
over a medically-related passage (near transfer) and a non-
medically related passage (far transfer) demonstrated signifi-
cantly better performance for the CACL group than for the
Control group. In addition, although the differences were
nonsignificant, the CACL group consistently performed better
than the Individual strategy group. These findings support
the contention that computer-assisted instruction and cooper-
ative learning can be combined to produce an effective delivery
system for the Paraphrase/Imagery learning strategy. The
positive findings for both dependent passages suggest that
the strategy acquired is substantially content-independent
and consequently, should be generalizable to a variety of
text materials.

In addition to group differences in performance on
free recall tests, analysis of the two salient factors of
a post-experimental questionnaire indicated that the CACL
group had significantly higher ratings than the Individual
group on both factors. The CACL group viewed the learning
strategies they received as more effective and their personal
gain from the experimental experiences as more positive
than the Individual group. Thus it can be speculated that
the members of the CACL group were able to benefit from
the social modeling provided by the other person in the
pair or from the management properties written into the
computer program or from an interaction of both technologies.

B. Development and Evaluation of the Networking Module

This second application of the CACL methodology was
designed to train students on the use of the Networking
strategy to transform incoming information into an alternate
form. This activity allows a student to personalize the
information, test degree of understanding, and enter multiple
encodings in memory.

In using the Networking Strategy the student identifies
important concepts or ideas in the material and represents
their interrelationships in the form of a network map.
To assist the student in this endeavor he/she is taught
a set of named links that can be used to code the relationships
between ideas. The networking processes emphasize the identi-
fication and representation of (a) hierarchies (type/part),

(b) chains (lines of reasoning/temporal orderings/causal sequences), and (c) clusters (characteristics/definitions/ analogies). Figure 1 is a schematic representation of these three types of structures and their associated links. Application of this technique results in the production of structured two-dimensional maps. These networks provide the student with a spatial organization of the information contained in the original training materials. Assessments of networking (Dansereau, McDonald et al., 1979; Holley et al., 1979) have shown that students using this strategy perform significantly better on text processing tasks than do students using their own methods.
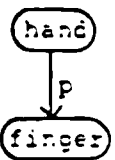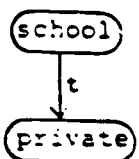
Networking skills are relatively easy to use when applied to short paragraphs or sentences, but applying the strategy to larger bodies of material such as textbook chapters could be an overwhelming task without some plan that tells how or when to begin. In order to provide a framework for using the Networking strategy effectively, the module also trained students on the use of the MURDER processing strategies developed by Dansereau, McDonald et al. (1979).

The input strategy, 1st degree MURDER, includes six steps for learning text material: (1) setting a proper Mood for learning, (2) reading for Understanding, (3) Recalling the information by drawing a network, (4) Detecting errors or omissions in the network, (5) Elaborating on the network to make information more easily remembered, and (6) Reviewing by creating an "overview" network which summarizes all the important and relevant information.
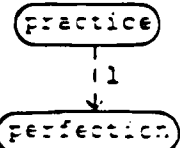
The 2nd degree MURDER strategy includes six steps for using the acquired information during task performance: (1) getting into a proper Mood for the task, (2) Understanding the goals and conditions of the task, (3) Recalling information relevant to the task, (4) Detecting omissions, errors, and ways of organizing the information, (5) Elaborating the information into a proper response, and (6) Reviewing the response to modify it if necessary.

During training, the students were first given instructions and practice to network sentences and short paragraphs based on familiar material. Then, they were given practice using networking in conjunction with 1st and 2nd degree MURDER in learning and recalling a medically related text excerpt. To evaluate the CACL methodology, a group of students trained in this fashion were compared with students given the same instructions and practice individually via written materials, and with students who studied the practice materials using their regular study and test-taking methods. Following training, all students, regardless of group affiliation, individually studied and took free recall tests over two passages. The first passage, which was medically related, was included to

HIERARCHY STRUCTURES

Part (of) Link	The content in a lower node is part of the object, process, idea or concept contained in a higher node.	Key Words is a part of is a segment of is a portion of
hand → p → **finger**		

Type (of)/ Example (of) Link	The content in a lower node is a member or example of the class or category of processes, ideas, concepts, or objects contained in a higher node.	Key Words is a type of is in the category is an example of is a kind of Three procedures are
school → t → **private**		

CHAIN STRUCTURES

Leads to Link	The object, process, idea, or concept in one node leads to or results in the object, process, idea, or concept in another node.	Key Words leads to results in causes is a tool of produces
practice → l → **perfection**		

CLUSTER STRUCTURES
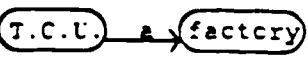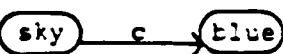
Analogy Link	The object, idea, process, or concept in one node is analogous to, similar to, corresponds to, or is like the object, idea, process, or concept in another node.	Key Words is similar to is analogous to is like corresponds to
T.C.U. → a → **factory**		

Characteristic Link	The object, idea, process, or concept in one node is a trait, aspect, quality, feature, attribute, detail, or characteristic of the object, idea, process, or concept in another node.	Key Words has is characterized by feature is property is trait is aspect is attribute is
sky → c → **blue**		

Evidence Link	The object, idea, process, or concept in one node provides evidence, facts, data, support, proof, documentation, confirmation for the object, idea, process or concept in another node.	Key Words indicates illustrated by demonstrated by supports documents is proof of confirms
broken arm → e → **x-ray**		

Figure 1

assess direct (near) transfer of training, and the second, which contained technical but non-medical content, was included to assess indirect (far) transfer. Pragmatic and logistical problems precluded the inclusion of pure CAI and cooperative learning treatments in the context of this experiment. The basic approach was to first determine the effectiveness of CACL and then, in subsequent studies, determine the relative contribution of the two component methodologies.

Methods

Participants

Participants in this experiment were 97 students from introductory psychology classes at Texas Christian University who were fulfilling a course requirement.

Materials

The training materials used in this experiment were designed by the authors to guide the students first in the use of the Networking strategy and then how to use Networking in connection with $MURDER_1$ and $MURDER_2$. Practice passages containing medical information were provided during training.

Two additional passages were used to assess the effectiveness of the strategy training. The first, which focused on descriptions, causes, and treatments of tumors (1,100 words), was selected to be similar to the practice passages. Performance on this served to assess direct (or near) transfer. The second passage was also technical in nature, but did not contain medical information. This 800-word passage, which described the fictional development and operation of an orbital tower connecting the earth to a satellite, served to assess indirect (or far) transfer.

Two individual difference measures were used as covariates in the analyses of treatment effects. The Delta Vocabulary Test (Deignan, 1973) is a 45-item multiple-choice test that correlates moderately with other measures of verbal aptitude (Dansereau, 1978). The Group Embedded Figures Test was developed by Oltman, Raskin, and Witkin (1971) to assess field dependence/independence. The individual must detect a simple geometrical figure contained within each of 18 more complex figures. This measure has been shown to be positively correlated with text processing performance (Witkin, Oltman, Raskin, & Karp, 1971).

Procedure

Each participant attended three two-hour sessions during a two-week period. During the first session participants were randomly assigned to one of three conditions: a Computer-

Assisted Cooperative Learning (CACL) group (n=29), an Individual Learning Strategy group (n=32), or a No-Treatment group (n=36).

The CACL group then worked in randomly assigned same-sex pairs and received computer-based training in Networking and its use in combination with the MURDER strategies. The pair partners interacted with one another and the Apple II microcomputers in learning the strategies. Medically related passages served as practice materials during this training.

At the same time, the Individual Learning Strategy group was given transcripts of the CACL computer programs as training materials. They studied this material individually. In all other respects, their training was identical to that of the CACL group. The No-Treatment group was exposed to all of the practice passages given the other two groups. They were told to use their own methods in studying these passages.

During the second session, the CACL and Individual groups took 25 minutes to complete their training, and the No-Treatment group spent the time writing an essay on the practice content material. Each group then studied a medically related passage on tumors for 45 minutes and a non-medically related passage on the fictional construction of an orbital tower for 40 minutes.

During the third session all participants took free recall tests which required them to list all the important ideas and facts they remembered from each of the two assessment passages. Eighteen minutes were allowed for each test. Then the subjects completed the Delta Vocabulary Test (Deignan, 1973) in ten minutes and the Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971) in 12 minutes. These two measures were used as covariates in the analyses of free recall performance. Subsequently the CACL and Individual groups completed a Satisfaction Questionnaire of 28 items, and the No-Treatment group answered an open-ended question about their methods of studying the passages.

Results

Trained raters scored the lists of ideas generated by the participants in session 3 according to predetermined keys for total points and number of propositions mentioned. This was done without knowledge of a participant's group affiliation. There was one team of two raters for each of the passages. One rater on each team scored all the free recalls and the second rater scored a subset of these passages to assess reliabilities. The tumors passage raters

achieved reliabilities of 0.84 for total points and 0.94
for propositions mentioned. The orbital tower raters achieved
reliabilities of 0.96 for total points and 0.96 for propositions
mentioned.

Based on the opinions of expert raters, the lists of
propositions were divided into main and detail ideas. Total
points for main and detail ideas were determined for each
passage, and accuracy ratios were computed by dividing each
total point score by the number of mentions for each measure.
The total scores and accuracy ratios were used as dependent
measures. Two-way analyses of covariance with passages
as the repeated measure and Delta Vocabulary Test and the
Group Embedded Figures Test as covariates indicated significant
differences among the three experimental groups for main
ideas total points, $F(2, 92) = 6.02$, $p<.004$, for main ideas
accuracy, $F(2, 92) = 7.60$, $p<.002$, for detail ideas total
points $F(2, 92) = 6.48$, $p<.003$, for detail ideas accuracy,
$F(2, 92) = 3.74$, $p<.03$. Effects due to passages and passage
treatment interactions were nonsignificant. Adjusted and
unadjusted means and standard deviations for each group
are listed in Table 3. The parallelism of the within-cell
regression slopes was tested for each analysis, and in all
cases the regression slopes were found to be homogeneous.

Post hoc analyses (Tukey's HSD) indicated that the
significant main effect for the main ideas total points
score was accounted for by the difference between the CACL
group and the Individual Study group, $p<.05$. For the other
three dependent measures, there were significant differences
($p<.05$) between the CACL and Individual Study groups and
the CACL and Control groups. No other differences reached
significance. In all cases, the CACL group had the lowest
mean performance.

To look for possible explanations for the consistently
poorer performance of the CACL group, the groups were further
divided into high and low scores (median split) on the Delta
Vocabulary Test, and into high and low scores on the Group
Embedded Figures Test . Three-way analysis of variance
with group membership, high or low Delta Vocabulary score,
and passage as the three factors demonstrated the expected
pattern of significant main effects for both group membership
and Delta Vocabulary score for main ideas total points,
$F(2, 91) = 4.23$, $p<.02$, and $F(1, 91) = 15.44$, $p<.001$; for
main ideas accuracy, $F(2, 91) = 5.66$, $p=.01$, and $F(1, 91) =$
12.00, $p=.01$; and for detail ideas total points, $F(2, 91) =$
4.77, $p=.011$, and $F(1, 91) = 18.77$, $p=.01$. However, for detail
ideas accuracy, only Delta Vocabulary scores were significant,
$F(1, 91) = 7.14$, $p<.01$. The anticipated interaction between
group and vocabulary score was nonsignificant. (See Tables
4 and 5 for means and standard deviations.)

Table 3

Means and Standard Deviations[a] for CACL Group[b] vs. Individual
Strategy Group vs. Control Group on Recall of Main Ideas Totals,
Main Ideas Accuracy, Detail Ideas Totals, and Detail Ideas Accuracy

	Unadjusted			Adjusted		
	CACL	Individual	Control	CACL	Individual	Control
TUMORS						
Main	-.317	.273	.012	-.371	.361	-.022
	(.946)	(1.109)	(.886)	(.902)	(.980)	(.627)
Main Accuracy	-.494	.126	.286	-.536	.201	.253
	(1.105)	(.951)	(.908)	(1.039)	(.837)	(.897)
Details	-.320	.030	.231	-.382	.130	.192
	(.725)	(1.066)	(1.084)	(.688)	(.955)	(1.007)
Detail Accuracy	-.215	.011	.163	-.258	.086	.131
	(.928)	(.981)	(1.065)	(.886)	(.924)	(1.022)
ORBITAL TOWER						
Main	-.200	.183	-.002	-.254	.270	-.036
	(.794)	(.988)	(1.144)	(.730)	(.933)	(.956)
Main Accuracy	-.246	.175	.043	-.288	.251	.009
	(1.098)	(.947)	(.950)	(1.038)	(.900)	(.818)
Detail	-.405	.197	.151	-.467	.297	.112
	(.753)	(.989)	(1.108)	(.732)	(.764)	(.908)
Detail Accuracy	-.361	.196	.117	-.405	.271	.085
	(.887)	(1.093)	(.948)	(.850)	(1.059)	(.821)

[a]Standard deviations are in parentheses. [b]Group $\underline{N}$s are: CACL=29;
Individual=32; Control=36.

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Table 4

Means and Standard Deviations[a] for High vs. Low Delta Vocabulary

Score and CACL Group vs. Individual Strategy Group vs. Control Group

on Recall of Main Ideas Totals, Main Ideas Accuracy, Detail Ideas

Totals, and Detail Ideas Accuracy for Tumors Passage

	TUMORS			
Group[b]	Main Ideas Totals	Main Ideas Accuracy	Detail Ideas Totals	Detail Ideas Accuracy
High Delta				
CACL	-.168	-.234	-.181	-.127
	(.99)	(.99)	(.71)	(.77)
Individual	.954	.185	.659	.433
	(1.10)	(.69)	(1.01)	(.81)
Control	.206	.251	.556	.278
	(.93)	(.83)	(1.15)	(1.04)
Low Delta				
CACL	-.456	-.737	-.449	-.296
	(.91)	(1.19)	(.74)	(1.08)
Individual	-.192	.085	-.400	-.278
	(.87)	(.96)	(.89)	(1.00)
Control	-.197	.326	-.133	.034
	(.81)	(1.01)	(.91)	(1.11)

[a]Standard Deviations are in parentheses. [b]Group Ns are: High

Delta: CACL=14; Individual=13; Control=19; and Low Delta: CACL=

15; Individual=19; Control=17.

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Table 5

Means and Standard Deviations[a] for High vs. Low Delta Vocabulary Score and CACL Group vs. Individual Strategy Group vs. Control Group on Recall of Main Ideas Totals, Main Ideas Accuracy, Detail Ideas Totals, and Detail Ideas Accuracy for Orbital Tower Passage

ORBITAL TOWER

Group[b]	Main Ideas Totals	Main Ideas Accuracy	Detail Ideas Totals	Detail Ideas Accuracy
High Delta				
CACL	.014	.135	-.342	-.250
	(.82)	(.97)	(.69)	(.93)
Individual	.474	.677	.794	.517
	(1.06)	(.71)	(.87)	(.81)
Control	.409	.480	.672	.497
	(1.09)	(.77)	(1.22)	(.98)
Low Delta				
CACL	-.400	-.602	-.465	-.465
	(.74)	(1.12)	(.82)	(.86)
Individual	-.016	-.168	-.211	-.024
	(.91)	(.94)	(.86)	(1.22)
Control	-.461	-.446	-.431	-.309
	(1.05)	(.91)	(.57)	(.72)

[a]Standard Deviations are in parentheses. [b]Group Ns are: High Delta: CACL=14; Individual=13; Control=19; and Low Delta: CACL=15; Individual=19; Control=17.

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A similar analysis of variance with group membership, high or low Group Embedded Figures (GEFT) score, and passage as the three factors showed a similar pattern of significant main effects for group membership and GEFT score for main ideas total points, $F(2, 91) = 3.16$, $p<.05$ and $F(1, 91) = 4.23$, $p<.05$; and for detail ideas total points, $F(2, 91) = 4.47$, $p=.014$ and $F(1, 91) = 5.86$, $p<.05$. For the main ideas accuracy scores, group membership was significant, $F(2, 91) = 4.82$, $p<.01$. In addition, the passage by GEFT score interaction approached significance, $F(1, 91) = 2.08$, $p=.06$. (See Tables 6 and 7 for means and standard deviations.)

The two study passages, Tumors and Orbital Tower, were divided into thirds, and a total score (sum of main and detail ideas) for each third of the passage was analyzed to look for group differences. Two-way analyses of covariance (group x passage), with Delta Vocabulary and GEFT as the covariates, demonstrated significant main effects of group for part 1, $F(2, 92) = 5.15$, $p<.01$, for part 2, $F(2, 92) = 5.24$, $p<.01$, and for part 3, $F(2, 92) = 5.90$, $p<.01$. Post hoc analyses with Tukey's HSD showed significant differences between the Control and CACL groups and Individual and CACL groups on part 1, and Individual and CACL groups on parts 2 and 3, $ps<.05$. There were no significant passage effects or passage by group interactions. (The means and standard deviations can be found in Table 8.)

Principal components analysis of the satisfaction question- naire revealed two factors: one, an evaluation of the overall effectiveness of the learning strategy, and the other, an assessment of the delivery system for the strategy. The first factor accounted for 42.6% of the variance and the second for 11.6%.

Two scales were constructed by adding together (with unit weightings) those items with factor loadings greater than .3. Reliabilities were assessed, and coefficient alpha was 0.95 for the first scale and 0.72 for the second. Twenty-one items were included in the creation of the first scale, and five items were included in the second. To assess group differences on the scales, two t-tests were run, and results indicated that there were no differences in the evaluations of the strategy effectiveness, $t(53) = 0.49$, $p>0.6$, or the delivery system effectiveness, $t(54) = -.31$, $p>.75$, as reported by the CACL group and the Individual Study groups. (See Table 9 for means and standard deviations.)

To assess group differences in the quality of networks produced during the study period, the networks were scored for total number of nodes, total number of links, the number of unlabeled links, and the longest node-link path. Two-way analyses of variance with passages as the repeated measure

Table 6

Means and Standard Deviations[a] for High vs. Low Group Embedded
Figures Test Score and CACL Group vs. Individual Strategy Group
vs. Control Group on Recall of Main Ideas Totals, Main Ideas
Accuracy, Detail Ideas Totals, and Detail Ideas Accuracy for
Tumors Passage

	TUMORS			
Group[b]	Main Ideas Totals	Main Ideas Accuracy	Detail Ideas Totals	Detail Ideas Accuracy
High GEFT				
CACL	-.255	-.497	-.243	-.179
	(.96)	(1.07)	(.73)	(.96)
Individual	.461	.057	.295	-.032
	(1.22)	(.96)	(1.14)	(1.11)
Control	.181	.238	.327	.111
	(1.09)	(.67)	(1.16)	(1.15)
Low GEFT				
CACL	-.405	-.490	-.428	-.265
	(.96)	(1.20)	(.73)	(.93)
Individual	.086	.194	.234	.054
	(.98)	(.75)	(.95)	(.87)
Control	-.095	.317	.170	.196
	(.74)	(1.05)	(1.06)	(1.03)

[a]Standard deviations are in parenthese. [b]Group Ns are: High
GEFT: CACL=17; Individual=16; Control=14; and Low GEFT:
CACL=12; Individual=16; Control=22.

Table 7

Means and Standard Deviations[a] for High vs. Low Group Embedded
Figures Test Score and CACL Group vs. Individual Strategy Group
vs. Control Group on Recall of Main Ideas Totals, Main Ideas
Accuracy, Detail Ideas Totlas, and Detail Ideas Accuracy for
Orbital Tower Passage

| | ORBITAL TOWER | | | |
Group[b]	Main Ideas Totals	Main Ideas Accuracy	Detail Ideas Totals	Detail Ideas Accuracy
High GEFT				
CACL	-.070	-.280	-.189	-.214
	(.96)	(1.20)	(.80)	(.97)
Individual	.261	.277	.428	.365
	(.99)	(.87)	(1.03)	(.88)
Control	.455	.192	.610	.389
	(.81)	(.91)	(1.25)	(1.08)
Low GEFT				
CACL	-.384	-.198	-.712	-.570
	(.45)	(.98)	(.58)	(.75)
Individual	.105	.074	-.033	.007
	(1.02)	(1.04)	(.93)	(1.27)
Control	-.292	-.053	-.141	-.056
	(1.24)	(.98)	(.92)	(.83)

[a]Standard deviations are in parentheses. [b]Group $\underline{N}$s are: High
GEFT: CACL=17; Individual=16; Control=14; and Low GEFT:
CACL=12; Individual=16; Control=22.

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Table 8

Means and Standard Deviations[a] for CACL Group[b] vs. Individual
Strategy Group vs. Control Group on Recall of Main Ideas Totals,
Main Ideas Accuracy, Detail Ideas Totals, and Detail Ideas Accuracy
on Parts 1, 2, 3 of the Tumors and Orbital Tower Passages

	Unadjusted			Adjusted		
		TUMORS				
	CACL	Individual	Control	CACL	Individual	Control
Part 1						
	-.295	.101	.148	.338	.170	.121
	(.90)	(1.13)	(.93)	(.89)	(1.07)	(.94)
Part 2						
	-.237	.013	.180	-.300	.115	.140
	(.62)	(1.00)	(1.22)	(.66)	(.94)	(1.19)
Part 3						
	-.360	.236	.081	-.411	.320	.047
	(.70)	(1.07)	(1.09)	(.69)	(1.01)	(1.06)
		ORBITAL TOWER				
Part 1						
	-.477	-.075	.011	-.520	-.006	-.016
	(.67)	(.94)	(1.00)	(.84)	(1.01)	(1.00)
Part 2						
	-.359	.191	.119	-.422	.294	.079
	(.94)	(.88)	(1.09)	(.97)	(.87)	(.99)
Part 3						
	-.257	.257	-.021	-.308	.341	-.054
	(.86)	(1.02)	(1.06)	(.93)	(.95)	(.98)

[a]Standard deviations are in parentheses. [b]Group Ns are: CACL=29;
Individual=32; Control=36.

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Table 9

Means and Standard Deviations[a] for CACL Group vs. Individual Strategy

Group of Factor 1 and Factor 2 of Post-Experimental Questionnaire

	STRATEGY EVALUATION	TRAINING EVALUATION
CACL	104.74	28.00
(n=27)	(36.58)	(7.72)
Individual	100.11	28.61
(n=28)	(33.00)	(6.98)

[a]Standard deviations are in parentheses.

indicated that the only significant difference between the CACL and the Individual Study groups was for unlabeled links, $F(1, 47) = 7.33$, $p<.01$. The Individual Study group produced more unlabeled links than the CACL group. (Means and standard deviations for each group are listed in Table 10.)

Discussion

The results of this study were disappointing in that the CACL module was ineffective in providing an improved environment for training students in the use of the Networking strategy. The Individual Strategy group and the Control group performed significantly better than the CACL group on main ideas accuracy, detail ideas total points, and detail ideas accuracy. The Individual group was significantly better than the CACL group on main ideas total points. In addition to the results from performance measures, there were no significant differences between the Individual and CACL groups in evaluation of the training methodology when completing a post-evaluation questionnaire.

This disappointing result in teaching the Networking strategy is very different from an earlier evaluation of the CACL module in the training of Paraphrase/Imagery skills within the structure of the MURDER strategies. That study showed both consistently superior performance by the CACL group over the Control group and significantly higher ratings by the CACL group than by the Individual group of the strategy training methodology.

The inconsistent results found in using the CACL methodology to train the two different strategies, Paraphrase/Imagery and Networking, suggest that the findings with Paraphrase/ Imagery were not due to placebo factors associated with the novelty of the CACL environment. If placebo effects were primarily responsible for the positive results in the Paraphrase/Imagery experiment, CACL/Networking should also lead to superior performance.

The differing results also point out the value of assessing the effects of new methodologies in diverse situations in order to define their appropriate implementation. In this case, the CACL methodology was used successfully to train Paraphrase/Imagery skills. These are strategies many people have in their repertoire but fail to use in a systematic fashion. The CACL module presumably increased the use of paraphrase and imagery by suggesting appropriate places to activate the strategy. The CACL module was unsuccessful in training the use of the Networking strategy, which is more complicated than simply restating ideas in one's own words and requires the learning of a new vocabulary of link

Table 10

Means and Standard Deviations[a] for CACL Group vs. Individual

Strategy Group on Use of Unlabeled Links for the Tumors and

Orbital Tower Passages

	TUMORS	ORBITAL TOWER
CACL	-.391	-0.351
(n=25)	(.600)	(.641)
Individual	-.297	0.273
(n=24)	(1.107)	(1.189)

[a]Standard deviations are in parentheses.

types and structures. In the current situation, with limited
training time and rapid introduction of cooperative learning,
the presence of computers and an unfamiliar strategy, there
was an overload on the students' resources.

Studies in social facilitation (e.g., Zajonc, 1966)
have shown that the presence of others tends to facilitate
the performance of well-learned responses and to inhibit
the learning and performance of new responses. The level
of arousal generated by others is optional for well-learned
responses and too great for new ones. The probability of
this effect is increased when the others who are present
are expected to evaluate one's performance or to demonstrate
by their performance that one's own performance is inferior
(Steiner, 1972).

In our study the arousal experienced by those persons
trained with the CACL module may have been elevated by working
with an unfamiliar partner or from the computer program
which evaluated their productions during training. This
arousal presumably decreased the ability to deal with unfamiliar
information and contributed to a situation of task overload.

More evidence supports the idea that the training method-
ology and the strategy interacted to overload the student.
The networks produced by the Individual Strategy group had
significantly more unlabeled links than the networks produced
by the CACL group. This suggests that the members of the
CACL group involved their resources in creating such detailed
networks that they were not able to adequately learn and
then recall the information in the study passages as well
as either the Individual group or the Control group. The
computerized presentation of the Networking strategy, with
its demands for interaction during training, may have had
a greater impact on the learner than did the written presentation
of the exercises. Presumably it was more difficult to ignore
or superficially process the information about the strategy
itself because of the feedback provided by the computer
program in response to student answers. The resulting emphasis
on producing good networks was apparently detrimental to
student performance on free recalls.

The overload idea can also be used to account for the
lack of significant differences between the Individual Strategy
group and the Control group, whose members used their own
methods to study. A previous study in which persons who
used Networking outperformed a Control group (Holley et al.,
1979), allowed much more time for training, approximately
7 hours in comparison to 2 in the present study. The greater
amount of training in the use of the strategy before its
application to study passages presumably made the link types

and structures so well-learned that they were easier to
use and distracted less from learning the information in
the passages.

The results of this study, when compared with the results
of earlier studies on Networking and on the CACL module,
suggest alterations to the training methodology to better
implement complex strategies such as Networking. The first
change is to allow more time for teaching the strategy than
was allowed in this study. Plans have been made to include
Networking as part of a fifteen-hour CACL program on learning
strategy implementation.

In addition to more time for training, stepwise introduction
of the module components may reduce overload on the individual
user. A sample scenario would first introduce the idea
of learning in pairs with a sample text passage and then
the use of computer-assisted instruction to guide learning
and finally the training on the strategy itself. This stepwise
introduction should decrease the debilitating feeling of
dealing with too many new tasks at one time.

C. Development and Evaluation of the Structured
   Summarization (DICEOX) Module

The results of the evaluation of "networking" suggested
that its complexity and unfamiliarity combined with the novelty
and complexity of the CACL training environment may have pro-
duced an overload on the participants and thus inhibited per-
formance. These findings are in marked contrast to the results
of the Summarization (paraphrase/imagery) evaluation in which
the CACL group strongly outperformed the Individual Strategy
and Control groups. As stated earlier, it is possible that
CACL is best suited for strengthening strategies (such as
summarization) that are relatively simple to use and have a
good deal in common with strategies already in the students'
repertoires. In order to explore the boundaries of this
possibility, a CACL module was developed that incorporated
structured summarization (DICEOX) within the MURDER strategies.

In using the structured summarization strategy the
student is taught to use a structural schema as a mechanism
for organizing the intermittent summaries. This schema,
given the acronym DICEOX, has six major categories (with
accompanying sub-categories) into which the student places
the information gained during reading: Description of the
major concept or idea, Inventor/historical background of
the idea, Consequences of the idea, Evidence for or against
the idea, Other competing or complementary ideas, and X-tra
information that does not easily fit into one of the above
categories. Our prior work (Brooks & Dansereau, 1983) has

shown that training on the use of this structural schema during learning and test-taking improves text recall. It is expected that students differing in aptitude and cognitive style will differentially prefer and benefit from the three modules we have developed: Summarization (paraphrase/imagery), Structured Summarization (DICEOX), and Networking. Eventually we would like to establish these relationships so that the strategy training can be tailored to the characteristics of the learner.

In order to assess the potential of CACL as a method for training structured summarization (DICEOX), four groups were employed: a CACL group, a group consisting of cooperating pairs of students that received the same training via written material, a group that received the written training individually, and a no-treatment group that employed their own study methods on the practice and test materials. This set of treatments not only allowed us to assess the effectiveness of DICEOX via CACL, but also allowed us to preliminarily determine the relative contribution of cooperative learning and computer-assisted instruction to the CACL system.

<div align="center">Method</div>

Participants

Participants were 105 students recruited from introductory psychology classes at Texas Christian University who were fulfilling a course requirement.

Materials

The training materials used in this experiment were designed to train the students in the acquisition and use of a structural schema (DICEOX) in the processing of text. The students were guided through practice passages via the $MURDER_1$ and $MURDER_2$ strategies.

The test materials used in the test phases of the experiment consisted of two passages of a technical nature. The first test passage focused on descriptions, causes, and treatments of tumors (1,100 words). The passage was in the same knowledge domain as the practice passages and performance on this served to assess direct transfer of the strategies. The second test passage was also technical in nature but did not contain medical information. The content of the passage was fictional and described the construction and operation of an orbital tower connecting the earth to a satellite (800 words). This passage was used to assess indirect transfer of the strategies.

The Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971) was administered in order to determine its correlation with the dependent measures. The GEFT, which provides a measure of field dependence/independence, requires individuals to detect simple shapes within complex figures. Field dependence/independence has been shown to relate to prose processing performance (Witkin, Oltman, Raskin, & Karp, 1971).

Procedure

The experiment was conducted in three sessions (approximately 2 hours per session). During the first session, participants were randomly assigned to one of four experimental conditions: (1) Computer-Assisted Cooperative Learning (CACL); (2) Dyadic Cooperative Learning Strategy (Dyads); (3) Individual Learning strategy (Individual); (4) No-Treatment (Control).

The CACL group worked in randomly assigned same-sex dyads and received computer-based training in using the DICEOX schema while implementing the $MURDER_1$ and $MURDER_2$ strategies. Each member of a dyad interacted with their partner and an Apple II microcomputer.

Students in the Dya° group also worked in randomly assigned same-sex pairs. They were given transcripts of the CACL computer programs as training materials and were asked to interact with their partner in learning the strategies.

The third group was comprised of individuals who received the same training as the previous two groups. The training materials differed only in that no interaction with another person was required. The Control group was exposed to all of the practice passages given to the other three groups. They were only to use their own methods in studying these passages.

During the second session, which took place two days later, the CACL, Dyad, and Individual groups completed their training. The Control group spent the time writing an essay on the practice passage content. All participants then studied both of the experimental passages. Each participant studied both passages alone.

In the third session (5 days later) all participants took free recall tests over the two passages studied during the second session. The GEFT was also administered during this session. Finally, the three experimental groups completed a post-experiment evaluation questionnaire and the Control group responded to an open-ended question about how they studied the passages.

Results

Each of the dependent measures was scored by trained raters according to predetermined keys and without knowledge of group affiliation. Two scores were computed for each of the passages studied. The first score was a total score which provided an assessment of the number and accuracy with which propositions from the test passages were recalled (total score). The second score provided a pure assessment of the number of propositions recalled (mention score). Interrater reliability for the dependent measures was obtained by having two raters score a randomly selected subset of each of the sets of free recall tests. Reliability coefficients (Pearson Product Moment correlations) of .84 and .87 were obtained for the Tumors passage. Coefficients of .96 and .95 were obtained for the Orbital Tower passage.

Two 2 x 2 repeated measures ANOVAs (group membership as the between factor and the near and far transfer passages as the repeated measure) were performed. The dependent measures were the total scores and the mention scores on the two passages.

The results of the ANOVA with total scores as the dependent measure indicated that there were significant between-group differences, $F(3, 78) = 2.741$, $p<.04$. The Spjøtvoll and Stoline modification of the Tukey HSD test (Kirk, 1982) was used to assess differences between group means. None of the simple comparisons between pairs of means reached significance although the differences between the CACL and Dyads groups and Control and Dyads groups approached significance. Clearly, a more complicated linear combination of the means is accounting for the significant main effect. Since these more complicated combinations are not of interest in this context, no further post hoc analyses were performed on these data. Neither the task factor nor the interaction between task and group were significant. The means and standard deviations are presented in Table 11.

The ANOVA for mentions also yielded significant between-group differences. Post hoc analyses (Spjøtvoll & Stoline's HSD) indicated that the difference between the means of the CACL and the Dyads groups was significant, $p<.01$. All other mean differences between groups were not significant. Again, the task factor and the interaction did not reach significance. (See Table 11 for means and standard deviations.)

In order to provide information about the relationship between cognitive style as measured by the GEFT and recall performance, simple within-group correlations (Pearson Product-

Table 11

Means and Standard Deviations for Group Performance on the
Dependent Measures

	Tumors Totals		Orbital Tower Totals	
	$\overline{X}$	SD	$\overline{X}$	SD
CACL (n=22)	.253	1.06	.254	.947
Pairs (n=24)	-.272	.849	-.513	.665
Individual (n=18)	-.087	.905	-.032	1.10
Control (n=18)	.1415	1.14	.40563	1.07

	Tumors Mentions		Orbital Tower Mentions	
	$\overline{X}$	SD	$\overline{X}$	SD
CACL (n=22)	.479	.914	.344	.963
Pairs (n=24)	-.362	.904	-.525	.769
Individual (n=18)	-.030	.981	.003	.998
Control (n=18)	-.071	1.05	.276	1.06

Moment) between the participants' GEFT scores and their
scores on the dependent measures were computed. These corre-
lations are presented in Table 12. Tests of significance
indicate that within the CACL group all correlations reached
significance at the .05 level. This finding suggests that
individuals with a tendency toward field independence perform
better under the CACL condition. In all other groups the
correlations were not significant.

The participants' evaluations of the strategy training
were assessed by means of a post-experimental evaluation
questionnaire. A principal components analysis was performed
on the participants' responses to the quesionnaire and yielded
a single factor. An ANOVA was subsequently conducted using
factor scores (unweighted totals of the items with loadings
>.3) as the dependent measures. No significant between-group
differences were found.

Discussion

The results of the study indicate that the CACL group
significantly outperformed the Dyad group on the mentions
scores. However, in general the results are disappointing
in that the CACL group did not significantly outperform
the Control group on any of the dependent measures. Although
the CACL group did achieve higher mean performances than
the Control group on three of the four dependent measures,
their relative performance was much poorer than that exhibited
by the CACL summarization group in the first evaluation.

There is some evidence to suggest that the performance
of the CACL/Structured Summarization group may have been
hampered by the same type of information processing overload
that was hypothesized as negatively impacting on those exposed
to the networking module. First, on the post-experimental
questionnaire approximately 50 percent of the CACL group
indicated that they were not confident about using the strategies
they had learned. This is in comparison to approximately
20 percent in the other two groups who expressed a lack
of confidence. Second, over 55 percent of the participants
across all treatment groups misapplied the DICEOX strategy
during the free recall tests. Supplementary analyses revealed
consistently lower mean performances on all dependent measures
by the subset of students who used the strategy inappropriately
than those students who didn't. These mean differences
were significant ($p<.05$) on the Orbital Tower totals and
approached significance for the Orbital Tower mentions score.

Table 12

Pearson Correlation Coefficients Relating Group Embedded
Figures Test Scores to Performance on the Dependent Measures

	Tumors Totals	Tumors Mentions	Orbital Tower Totals	Orbital Tower Mentions
CACL (n=22)	.5129 (p≤.007)	.3914 (p≤.036)	.5344 (p≤.005)	.4138 (p≤.028)
Pairs (n=24)	.0883 (p≤.341)	.0582 (p≤.394)	.2544 (p≤.115)	.1896 (p≤.187)
Individual (n=18)	.3575 (p≤.073)	.1368 (p≤.294)	.1023 (p≤.343)	-.0123 (p≤.481)
Control (n=18)	-.0070 (p≤.489)	0.0730 (p≤.387)	.0818 (p≤.373)	.0963 (p≤.352)

Finally, the significant correlations between the GEFT and the dependent measures within the CACL group suggest that field independents benefit from the training, while field dependents do not. This finding is in line with previous research that indicates that field independents are more effective than field dependents in complex, unfamiliar, instructional environments (DeLeeuw, 1983; Witkin, Moore, Goodenough, & Cox, 1977; Wittrock, 1979).

The uniformly poor performance of the cooperative dyad group suggests that a major source of the relatively poor performance of the CACL group may be the presence of another person while learning the strategy. The members of the dyad group had the worst performance on each dependent measure and yet felt more confident about their ability to use the strategies. In addition to overload they may have arrived at inappropriate views of their strategy capabilities due to the lack of computer feedback and interaction during training. The apparent disruptiveness of the presence of another person in this situation may not be that surprising in light of the social facilitation literature. Bond and Titus (1983) conducted a meta-analysis which indicated generally that the presence of others enhances the performance of simple, familiar tasks and impairs the performance of complex, unfamiliar tasks. The learning of the DICEOX strategy (as well as the networking strategy) may be too complex and unfamiliar to benefit from social facilitation.

General conclusions and recommendations based on this and the other evaluations will be presented in a subsequent section.

D. Development and Evaluation of the Mood Management Module

In addition to the major training modules described in the previous sections, we have also developed and informally evaluated a mood management module designed to enhance the participants' affective strategies. This module, which is based on our prior work with self-coaching and self-directed relaxation (Collins, Dansereau, Holley, Garland, & McDonald, 1981), is designed to improve concentration and motivation. Its primary purpose is to facilitate the participant's progress through the modules described earlier. As a consequence, it will appear at the front end of any extended training programs that are developed.

The mood management module is composed of the following:

-- A brief overview of the MURDER meta-strategies and a discussion of how mood management fits within these strategies.

-- A discussion of the importance of a good mood for effective studying and test-taking. The main theme is that individuals should achieve a state of relaxed attention to maximize skilled performance.

-- A series of simple steps for assessing and controlling mood are presented. These steps, which are based on self-coaching and self-directed relaxation, are subsequently discussed by the participants.

-- An audio cassette then guides the participants through a technique for assessing their mood.

-- A "tongue-in-cheek" essay entitled "How to Create and Maintain a Crummy Mood," is then presented in order to help the participants understand the barriers to achieving constructive mood states.

-- A second audio tape is provided which guides the participants through appropriate mood state-setting procedures.

-- After discussion of the second tape, a third audio tape is presented which guides the participants to a focused state of attention designed specifically for studying.

-- A summary of the module is then presented with suggestions on how to apply the mood management techniques in typical study and test-taking situations.

Throughout this module the participants are provided with opportunities to interact with the computer and with one another.

In order to preliminarily evaluate this module, nine undergraduate college students were exposed to the module and then given a two-item open-ended questionnaire as well as an 11-item scaled questionnaire designed to assess their reactions to the experience. Within this second questionnaire there were basically three categories of questions: those concerned with the effectiveness of the technique, those concerned with how well subjects believed they learned the technique, and those concerned with the subjects' general impression of the technique. The rating scale for each question was from 0 to 7 (0 indicating "negative" or "not at all" to 7 indicating "positive" or "extremely well.") The mean ratings were as follows: effectiveness, 5.25; learning of the technique, 4.78; general impression, 5.29. Based on the results of this questionnaire and informal observations of the participants, it appears that the module was well received and was viewed as providing valuable information. Comments by the participants also provided information on how the module might be improved.

IV. Conclusions and Recommendations

Within the pragmatic constraints that governed these evaluations (e.g., 2 hours of training, marginally motivated college student volunteers, relatively short dependent measure passages) it appears that CACL is an effective training vehicle for simple and somewhat familiar strategies (i.e., the MURDER metastrategies using paraphrase/imagery). With more complex and unfamiliar strategies such as networking and structured summarization (DICEOX), the CACL approach is not very effective under the experimental conditions that were imposed. Explanations based on an overload hypothesis appear to account for these findings. It should be noted that the negative findings with networking and structured summarization strengthen the idea that the results of the summarization (paraphrase/imagery) evaluation were not merely placebo (Hawthorne) effects arising from the novelty of the CACL environment. Rather, it appears that the summarization strategy results are sufficient to warrant the implementation of this module in field settings.

Based on our experiences, we believe that CACL training of networking and structured summarization (DICEOX) could be made to be effective by:

A. Extending the training time for each module and increasing the number of practice opportunities.

B. Integrating all of the modules into a single, 15-hour training program. If the summarization (paraphrase/imagery) strategy were taught first the participants would presumably adapt to the CACL environment and not suffer overload problems during the training of networking and structured summarization. Further, if the "mood management" module were provided at the "front end" of this program it might serve to reduce motivation and concentration problems.

C. Tailoring the training approach to characteristics of the learner. For example, there is some evidence from the structured summarization evaluation that field independent students should be given CACL training while field dependent students should be given some other form of instruction.

In addition to these development activities, it would be useful to conduct additional research in order to formally evaluate the mood component, examine the effective components of the CACL approach, and determine the validity of the "overload" hypothesis.

References

Bond, C. F., & Titus, L. J. (1983). Social facilitation:
A meta-analysis of 241 studies. Psychological Bulletin,
94(2), 265-292.

Brooks, L. W., & Dansereau, D. F. (1983). Effects of structural
schema training and text organization on expository prose
processing. Journal of Educational Psychology, 75(6),
811-820.

Collins, K. W., Dansereau, D. F., Holley, C. D., Garland,
J. C., McDonald, B. A. (1981). Control of concentration
during academic tasks. Journal of Educational Psychology,
73, 122-128.

Dansereau, D. F. (1978). The development of a learning
strategy curriculum. H. F. O'Neil, Jr. (Ed.), Learning
strategies. New York: Academic Press.

Dansereau, D. F. (in press). Learning strategy research.
In J. Segal, S. Chipman, & R. Glaser, (Eds.), Thinking
and learning skills: Relating instruction to basic research.
Vol. I. Hillsdale, NJ: Lawrence Erlbaum Associates.

Dansereau, D. F., Collins, K. W., McDonald, B. A., Holley,
C. D., Garland, J. C., Diekhoff, G., & Evans, S. H. (1979).
Development and evaluation of an effective learning strategy
program. Journal of Educational Psychology, 71, 64-73.

Dansereau, D. F., McDonald, B. A., Collins, K. W., Garland,
J. C., Holley, C. D., Diekhoff, G. M., & Evans, S. H.
(1979). Evaluation of a learning strategy system. In
H. F. O'Neil, Jr., & C. D. Spielberger, (Eds.), Cognitive
and affective learning strategies. New York: Academic
Press.

Deignan, G. M. (1973). The Delta reading vocabulary test.
Air Force Human Resources Laboratory, Lowry Air Force
Base, CO.

DeLeeuw, L. (1983). Teaching problem solving: An ATI study
of the effects of teaching algorithmic and heuristic
solution methods. Instructional Science, 12, 1-48.

Holley, C. D., Dansereau, D. F., McDonald, B. A., Garland, J. C., & Collins, K. W. (1979). Evaluation of a hierarchical mapping technique as an aid to prose processing. Contemporary Educational Psychology, 4, 227-237.

Kirk, R. E. (1982). Experimental design: Procedures for the behavioral sciences. Belmont, CA: Brooks/Cole Publishing Co.

McDonald, B. A., Larson, C. O., Dansereau, D. F., & Spurlin, J. E. (in press). Cooperative dyads: Impact on text learning and transfer.

Oltman, P. K., Raskin, E., & Witkin, H. A. (1971). Group embedded figures test. Palo Alto, CA: Consulting Psychologists Press, Inc.

O'Neil, H. F. (Ed.). (1978). Learning strategies. New York: Academic Press.

O'Neil, H. F., & Spielberger, C. D. (Eds.). (1979). Cognitive and affective learning strategies. New York: Academic Press.

Sharan, S. (1980). Cooperative learning in small groups: Recent methods and effects on achievement, attitudes, and ethnic relations. Review of Educational Research, 50, 241-271.

Singer, R. N. (1978). Motor skills and learner strategies. In H. F. O'Neil, Jr., (Ed.). Learning strategies. New York: Academic Press.

Slavin, R. E. (1980). Cooperative learning. Review of Educational Research, 50, 315-342.

Steiner, I. D. (1972). Group process and productivity. New York: Academic Press.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P.W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. Review of Educational Research, 77, 7-64.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971). A Manual for the Embedded Figures Test. Palo Alto, CA: Consulting Psychologists Press, Inc.

Wittrock, M. C. (1979). The cognitive movement in instruction. Educational Researcher, 8(2), 5-11.

Zajonc, R. B. (1966). Social psychology: An experimental approach. Belmont, CA: Wadsworth.

Holley, C. D., Dansereau, D. F., McDonald, B. A., Garland,
J. C., & Collins, K. W. (1979). Evaluation of a hierarchical
mapping technique as an aid to prose processing. Contemporary
Educational Psychology, 4, 227-237.

Kirk, R. E. (1982). Experimental design: Procedures for the
behavioral sciences. Belmont, CA: Brooks/Cole Publishing
Co.

McDonald, B. A., Larson, C. O., Dansereau, D. F., & Spurlin,
J. E. (in press). Cooperative dyads: Impact on text learning
and transfer.

Oltman, P. K., Raskin, E., & Witkin, H. A. (1971). Group embedded
figures test. Palo Alto, CA: Consulting Psychologists Press,
Inc.

O'Neil, H. F. (Ed.). (1978). Learning strategies. New York:
Academic Press.

O'Neil, H. F., & Spielberger, C. D. (Eds.). (1979). Cognitive
and affective learning strategies. New York: Academic Press.

Sharan, S. (1980). Cooperative learning in small groups:
Recent methods and effects on achievement, attitudes, and
ethnic relations. Review of Educational Research, 50, 241-271.

Singer, R. N. (1978). Motor skills and learner strategies.
In H. F. O'Neil, Jr., (Ed.). Learning strategies. New
York: Academic Press.

Slavin, R. E. (1980). Cooperative learning. Review of Educational
Research, 50, 315-342.

Steiner, I. D. (1972). Group process and productivity. New
York: Academic Press.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P.W.
(1977). Field-dependent and field-independent cognitive
styles and their educational implications. Review of
Educational Research, 77, 7-64.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971).
A Manual for the Embedded Figures Test. Palo Alto, CA:
Consulting Psychologists Press, Inc.

Wittrock, M. C. (1979). The cognitive movement in instruction.
Educational Researcher, 8(2), 5-11.

Zajonc, R. B. (1966). Social psychology: An experimental
approach. Belmont, CA: Wadsworth.